under three heads, classical boys, mathematical boys, and good-for-nothing boys. This last class exists mainly because the proper food for them has not been provided, they are allowed to starve for lack of it, and grow up as men with stunted and impoverished intellects; they have not been educated, the powers of their minds have not been drawn out by the fit means, and they pass through the world as animated failures.

Let Science work side by side with Classics and Mathematics—not usurp their places—in the work of education, and the good-for-nothing class will be very sensibly diminished, if indeed it be not entirely done away with. But how is this to be done? In the first place, gradually; in the second place, zealously; in the third place, thoroughly. Gradually, because it is a new thing, and a large proportion of our private schoolmasters have had no regular training in science themselves. Zealously, because if a teacher be not himself interested in what he teaches, he can have no assurance of success, and no encouragement from his pupils. Thoroughly, because a thing worth doing at all is worth doing well.

This is the spirit in which the work must be done, but what are the special means? Are boys to read about Science merely, or are they to touch and handle Science for themselves? It is doubtless a good thing to read about the truths of Science and their experimental illustration; it is a better thing to see those truths illustrated and proved by another; but it is by far the best thing to experiment upon and prove the truths by one's self. There is nothing that comes home so much to a boy's mind as an experimental proof. He may read of the dual character of electricity, and may get some vague ideas on the subject; as soon, however, as he takes two sticks of sealing-wax, suspends one, rubs both, and brings one near to the other, he, as it were, discovers for himself that the same bodies electrified by the same means repel one another, and on experimenting with glass and sealing-wax sticks he learns something of attraction, and is naturally led on from experiment to experiment until the powers of his mind become quite drawn out, or educated in the pleasurable pursuit of the subject. In the Science-teaching of boys, then, practical demonstrations must play an important part. Let reading, hearing lectures, and attending classes, and individual experimentation, be the working tools. A lecture of itself is but a poor tool, it produces an effect for the time, but in many cases no very permanent good. A lecturer must also be a teacher out of lecture hours.

As a commencement of Science-teaching in schools we commend the following plan to the notice of Science-teachers. Let one or two evenings in the week be set apart for lectures on some branch of Science, Experimental Physics, Botany, or Geology. Each lecture to last *not more* than an hour, and to be experimentally illustrated in the way best suited to the subject, always bearing in mind that the simplest experiments, or those most easily imitated by the pupils, are the best. Let the pupils be encouraged to take notes, and let the lecturer sum up in a concise form at the end of the lecture the main points established, which may be written in the form of memoranda on a black board and copied by the pupils. A day or two after the lecture let him hold a conversational class, the attendance optional. He will then briefly run over the matter of the last lecture, find out by questioning what points are not thoroughly understood, re-explain or even re-experiment, and endeavour to leave each mind with a perfect understanding of fundamentals. On a third evening let him give a series of simple—not needlessly puzzling—examination questions, and look over each boy's answers with himself alone, if possible, in order to give an opportunity for a yet more thorough explanation of any difficult point suited to the individual capacity of each. Instead of a string of questions, a subject for an essay in connection with the lectures might occasionally be given. Private reading of text-books should always be encouraged.

Now, as to the results of a system of this kind, taking such a subject as Experimental Physics, it will be found that the lectures are always looked forward to with no ordinary pleasure, and are listened to with no ordinary attention. At the conversational classes the way in which such subjects teach boys to think is often clearly seen; they ask most puzzling questions, yet natural ones, and in many cases seek to go far deeper into the subject than the lecturer had at first any idea of leading them. This general interest incites them to read and perform such simple experiments for themselves as are within their power.

Generally speaking it is not the high classical or even the mathematical boys that have excelled in Science learning, but precisely those who before occupied no prominent place in the school, had no special gift for classics or mathematics, and were considered, more or less, good-for-nothings. And here it is important to remember that a person may have a mathematical mind without being a mathematician.

While such subjects as Chemistry and Physics claim, perhaps, the highest position as a means of scientific education, it is important to vary the programme as much as possible without treating any superficially. Thus Astronomy, Geology, Physiology, and Botany have strong claims. It is certainly most deplorable to think that even now in many of our private schools the pupils are being tacitly taught that the world was made in six days, and that man is but some 6,000 years old. They might as well learn that there are but four elements—earth, air, fire, and water. We look with confidence for better things in the future.

COHN'S CONTRIBUTIONS TO THE BIOLOGY OF PLANTS

Beiträge zur Biologie der Pflanzen. Herausgegeben von Dr. Ferdinand Cohn. Erster Heft. Mit sechs zum theil farbigen Tafeln. (Breslau, 1870. London: Williams and Norgate.)

THIS is the first part of a new periodical established primarily for the publication of the results of the observations made at the Botanico-Physiological Institute at Breslau. The part contains five papers on different microscopic algæ and fungi, and their pathological effects. In subsequent numbers it is intended to give priority to botanical observations which relate to biological questions, or which are more or less connected with practical natural science, medicine, agriculture, &c. It is hoped that the publication may fill the place formerly occupied by Karsten's "Botanische Untersuchungen."

We propose here to give a short account of the contents of the present number. The first paper (by Dr. J. Schroeter) is on the parasites of the genus *Synchytrium*. The *Synchytria* form a small group of parasitic cryptogams, remarkable for their peculiar mode of development and the absence of any mycelium. They produce small swellings, or "galls," on the plants in which they occur, but in comparison with other parasites cause little injury or distortion. The genus was established by De Bary and Woronin in 1863 for the reception of the plant now known as *Synchytrium Taraxaci*. Several other species have since been discovered, the number of those described by Dr. Schroeter in the present paper amounting to eleven. The plants were divided by Woronin into two groups. In the first the protoplasm of the cells is white, and the zoospores pass at once into the condition of resting spores. In the second group the protoplasm is reddish, and the zoospores, attaching themselves to living plants, produce spherical masses of zoosporangia until the close of the vegetative period, when they produce resting spores. Dr. Schroeter proposes three groups, which he calls *Eusynchytrium*, *Chrysochytrium*, and *Leucochytrium*. The first corresponds to Woronin's second group, the second to Woronin's first group, and the third comprehends certain *Synchytria* which agree with those of Woronin's first group except in having white protoplasm. Dr. Schrœter describes the species with great care, and in considerable detail, and the descriptions are for the most part illustrated by excellent plates. He considers the genus to be one of wide distribution. With regard to its systematic position, there has never been any doubt that *Synchytrium* belongs to the *Chytridiaceæ*, but whether the latter are fungi or algæ is not so well settled. The conclusion at which the author has arrived is that they should be placed as a distinct family amongst those *Palmellaceæ* which produce zoospores, being nearly related to *Hydrocytium*, *Codiolum*, and their allied genera.

In the second paper ("Ueber die Fäule der Cactusstämme") MM. Lebert and Cohn describe a new species of *Peronospora*, which was most destructive to a collection of cactuses, affecting particularly *Cereus giganteus* and *Melocactus nigrotomentosus*. The epidermis of the cactus was not materially altered, but the cellular tissue beneath became entirely rotten, the decay beginning with the inter-cellular substance: so that the parenchymatous cells were easily separable from one another. The contents of these cells became brown, and the cell-membrane almost entirely dissolved, the cactus thus exhibiting an internal state of decay similar to that seen in diseased potatoes. The fungus is closely allied to the potato blight, *Peronospora infestans*, which it resembles in having the hyphæ only slightly ramified, not dichotomous and therefore producing but few conidia, as well as in its delicate mycelium (which has no suckers) and in the swellings underneath the large, beaked conidia. The authors suspect that the fungus must have been imported with the cactuses from America.

The third paper, by Dr. Cohn, is entitled "Ueber eine neue Pilzkrankheit der Erdraupen," and contains a detailed account of a fungoid disease affecting the caterpillars of *Agrotis segetum*. The skin turns black, a coal-black pigment appears in the blood, and the caterpillar becomes a wrinkled and brittle mummy. Upon examining the interior the whole cavity of the body, except the intestinal canal, is full of a black tinder-like substance, consisting of very large, dark brown spores, which are globular, but sometimes wrinkled at the surface, so as to present a crenate outline under the microscope. Contemporaneously with the colouring of the blood, cylindrical or curved tubes (*Schläuche*) are seen, which become divided by septa, and form rows of cells which separate from one another and appear in the blood as free globular or oval cells. These Dr. Cohn calls *gonidia*. These gonidia germinate shortly before the death of the grub, and produce a mycelium which displaces the inner organs, except the intestinal canal and the tracheæ, and fills the hollow of the body. This mycelium produces partly new gonidia and partly the dark spores already mentioned. The latter are probably resting-spores, as it seems from Dr. Cohn's observations that they do not germinate until the spring. The fungus (to which the author gives the name *Tarichium*) appears to be generically the same as Fresenius's *Entomophthora*, and to be closely allied to *Empusa*. Dr. Cohn thinks it not improbable that *Empusa* and *Tarichium* are stages of development of the same fungus; that *Empusa* may be the conidial form of a fungus of which *Tarichium* represents the teleutospores. If so, *Empusa* bears the same relation to *Tarichium* as *Oïdium* does to *Erysiphe*, *Uredo* to *Puccinia*, and (perhaps) as the *epi*phytal conidia of *Peronospora* to the *endo*phytal oospores.

We have but little space to notice the two remaining papers. One is by Dr. Schroeter, and relates to a disease affecting *Pandanus*, which was observed many years ago by Sinnig, the Inspector of the Botanic Garden at Poppelsdorf, and which has since been investigated by Bouché, at Berlin. In the spring of the present year it attacked a splendid specimen of *Pandanus odoratissimus*, Jacq., in the gardens at Breslau; the branches decayed, and it was found necessary to cut off the crowns, afterwards the branches themselves, and eventually the greater part of the entire plant, leaving only a portion of the stem and a single branch. A strict investigation afforded no ground for supposing that the disease had been produced by cold, drip, or other causes which would suggest themselves to cultivators, but a fungus was discovered identical with one described by Leveillé as long ago as 1845, which occurred in the Botanic Garden at Paris upon *Pandanus*, and which he called *Melanconium Pandani* (Ann. d. Sciences Nat. ser. iii. t. 3, p. 66). The *Melanconium* in the present case was accompanied by a *Nectria*, which Dr. Schroeter considers to be the *Nectria Pandani*, Tul., and conidia were also observed, the mycelia of which exhibited the forms of *Tubercularia*, *Stilbum*, and *Verticillium* or *Penicillium*. The author considers it extremely probable that the *Melanconium*, the *Nectria*, and the conidia are produced from the same mycelium, the fungus thus exhibiting the following forms of fruit:—1. Grey-green conidia (*i.e.* the *Melanconium* fructification). 2. Colourless conidia, the supports of which assume three different forms, viz. (*a*) *Tubercularia*, (*b*) *Stilbum*, (*c*) the form of such moulds as *Verticillium* or *Penicillium*. 3. Spores in asci formed in orange-red perithecia seated on a *Stroma*.

Dr. Schroeter concludes that there can hardly be a doubt that the fungus is the direct cause of the progress and of the destructive operation of the malady, and that it is probable, though not so certain, that the spores germinate in the healthy stem, and actually produce the disease.

The last paper contains a description by Dr. Cohn of a plant which he has discovered in well-water at Breslau, and to which he has given the name of *Crenothrix polyspora*. The genus is new and is closely allied to *Chamæsiphon*, being intermediate between that and *Lyngyba*. It would take too much space to describe the plant at length, for the particulars of which we must refer to the paper, in which will be found, moreover, some interesting observations upon the microscopical analysis of well-water in general. The *Crenothrix* was first noticed in water from a well at Breslau, in a part of the town notorious for the prevalence of typhus. It has been found also in other wells of bad reputation, but whether it has any injurious effect upon the health of the dwellers in the neighbourhood of the wells in question Dr. Cohn cannot venture to say.

It will be seen, from what has been said, that the periodical under notice is well deserving the attention of botanists and physiologists, and from the reputation of its editor there is every reason to hope that the scientific interest of future numbers may equal that of the present one.

F. CURREY

OUR BOOK SHELF

Matheran Hill, its People, Plants, and Animals. By J. Y. Smith, M.D. (Edinburgh: Maclachlan and Stewart.)

THIS is perhaps the first attempt that has been made to give a comprehensive account of the natural history of any particular spot in our East Indian possessions, and we welcome this little book as a sample of what may be accomplished by residents there in the midst of their official occupations. The undertaking is worthy of all praise, and, as far as it goes, it is a valuable contribution to the ethnology and natural history of India, and will no doubt be the groundwork for further research, and lead to other similar works.

The hill of Matheran is within twenty miles of the coast of Bombay, it is basaltic, and rises in the centre of a vast plain to the height of about 2,600 feet, it is precipitous on all sides, flat on the summit, which has an area of about five square miles, and is clothed with luxuriant vegetation; it is, in short, one of the most charming spots in India. In less than three hours one can be transported from the heat, dust, and noisy traffic of Bombay to what appears to be another world, where the body is refreshed and invigorated by the pure mountain air, and the spirit soothed by the beauty of verdant foliage, the cheerful music of feathered songsters, scenery grand and picturesque, and the general repose of nature. To the naturalist Matheran opens a grand volume to him, the little plateau has an air of enchantment, and he has spread out before him in the most attractive form objects which will supply him for even years with delightful and instructive occupation without the toil and exposure of long journeys. To such Dr. Smith's account of the more prominent objects to be met with will therefore be a valuable boon, and, indeed, to all lovers of nature who may visit the place. Let the home botanist imagine himself in a pretty little cottage on Matheran, with no less than seventy-five flowering trees and shrubs within a mile of his residence; not to mention climbing plants, creepers, herbs, parasites, and ferns in abundance. As the author is now returning to the East, we hope he will have opportunities of extending his interesting observations, especially on the birds and insects. To the geologist, Matheran is an object of interesting study; he will there see that curious rock called laterite or iron stone clay, the nature of which has been so much disputed, capping the great basaltic formation (to use a homely phrase) like the sugar on a Christmas cake, and if he extends his observations to the north and south, he will find the same capping on other hills, thirty to sixty miles distant, while no trace of it exists in the interval between. To what bold speculations does this fact give rise? Did this laterite once cover the whole country as with a mantle, and are present appearances due to a vast denudation of hard trappean rock 2,000 to 3,000 feet deep?

We are glad to find natural history included among the subjects for Indian Civil Service examinations, for hitherto this class of Europeans in India have contributed comparatively little to our knowledge of that wonderful land "where all, save the spirit of man, is divine."

A Voyage Round the World. By the Marquis de Beauvoir. 2 vols. (Murray, 1870.)

THIS is the gossiping journal of a young companion of the Duc de Penthièvre, son of the Prince de Joinville, often amusing and spirited, but of little permanent value. We have the usual exaggerations of a novice in the tropics. At Batavia he speaks of "this torrid temperature of 104° in the shade," a degree of heat never experienced by the present writer during many years' residence in those regions. The author's scientific attainments may be estimated by his account of his visit to the Melbourne Museum, when he makes Prof. MacCoy speak in this fashion:—"The stratum of alluvial soil covering the crust of primitive rocks, which formed round the earth while it was still in a liquid and incandescent state, possesses the same specific type of animal life that characterises the ancient strata of Wales, Sweden, and North America. Then come soils identical with those of these countries, schist and fossil rocks; thus Canada, Scotland, and the province of Victoria have all passed through the same form of existence at this remote period." The countries described are Australia, Java, Siam, and Canton, and the whole journey occupied about six months.

A. R. W.

The Student and Intellectual Observer. A Quarterly Journal of Science, Literature, and Art. Vol. 5. (London: Groombridge and Sons.)

THE volume now before us is in every way worthy of the reputation of its predecessors. Four papers on poison are contributed by Mr. F. S. Barff, and Dr. Carpenter contributes two interesting papers on the "Deep Sea," the first on its physical, and the second on its biological condition. The author's experience in these matters, owing to his connection with recent explorations, make the papers the more interesting, because they are the words of an actual and accurate observer. Dr. Collingwood also gives a very readable paper on a kindred subject, "The Sargasso Sea and its Inhabitants," in which the Sargassum or Gulf-weed comes in for a good share of attention, being, as it is, the home of multitudes of Polyzoa, Polyps, Crustacea, Molluscs, and similar creatures. Mr. Shirley Hibberd talks about Cycads under the very misleading title of "Sago Palms." At one time the Sago of commerce was supposed to be the produce of the Cycads, but now we know that the bulk of this useful article is yielded by two or more species of *Sagus*, true palms; it is, to say the least, advisable that an old term proved to have been wrongly given, should not be perpetuated. The author, however, does attempt to qualify its use in the following sentence:—"By 'Sago Palms' is to be understood the great group of gymnospermous plants, of which the Cycads and their allies are representatives, a group possessing powerful morphological relations, and, of course, a correspondence within certain limits in all their biological characteristics." The volume contains many other interesting papers in various branches of science, and we conclude this short notice by wishing well to an old-established monthly in its new quarterly form.